

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : Klaus ENDRES et al. **Confirmation No.: 8426**  
Group Art Unit: 1796  
Appl. No. : 10/587,362  
Examiner: Li, Aiqun  
I. A. Filed : January 28, 2005  
For : CONSOLIDATION AGENTS AND THE USE THEREOF FOR  
CONSOLIDATING MOLDED BODIES AND GEOLOGICAL  
FORMATIONS CONSISTING OF POROUS OR PARTICULATE  
MATERIALS

**APPEAL BRIEF UNDER 37 C.F.R. § 41.37**

Commissioner for Patents  
U.S. Patent and Trademark Office  
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401 Dulany Street  
Alexandria, VA 22314

Sir:

This Appeal is from the Examiner's rejection of claims 11-30 set forth in the Final Office Action mailed from the U.S. Patent and Trademark Office on July 8, 2009.

A Notice of Appeal in response to the July 8, 2009 Final Office Action was filed on October 8, 2009.

The requisite fee under 37 C.F.R. § 41.20(b)(2) for filing this Appeal Brief is being paid concurrently herewith. The Patent and Trademark Office is hereby authorized to charge any additional fees that may be deemed necessary for maintaining the pendency of this application, including any appeal or extension of time fees that may be deemed necessary, to Deposit Account No. 19-0089.

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### **I. REAL PARTY IN INTEREST**

The real party in interest in this appeal is Leibniz-Institut fuer Neue Materialien Gemeinnuetzige GmbH of Saarbruecken, Germany. The corresponding assignment was recorded in the U.S. Patent and Trademark Office on September 28, 2006 at REEL 018347, FRAME 0994.

### **II. RELATED APPEALS AND INTERFERENCES**

Appellants, Appellants' representative or the Assignee are not aware of any prior and pending appeals, interferences or judicial proceedings which may be related to, directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

### **III. STATUS OF CLAIMS**

The status of the claims is as follows:

Claims 11-30 are pending in this application.

Claims 1-10 are cancelled.

Each of claims 11-30 is indicated as rejected in the Final Office Action mailed July 8, 2009 and the Advisory Action mailed September 23, 2009.

The rejection of each of claims 11-30 is under appeal. Claims 11-30 involved in the appeal are reproduced in the Claims Appendix attached hereto.

#### IV. STATUS OF AMENDMENTS

No Amendment has been filed subsequent to the Final Office Action mailed July 8, 2009.

#### V. SUMMARY OF CLAIMED SUBJECT MATTER

Independent claim 11, the only independent claim, is drawn to a consolidation agent for molded articles and geological formations comprising porous materials and/or particulate materials. The agent is particle-free and comprises a hydrolysate and/or a precondensate of (a) one or more organosilanes of formula (I)



wherein the radicals R independently represent non-hydrolysable groups, the radicals X independently represent hydrolysable groups or hydroxyl groups, and n is 1, 2 or 3; and (b) optionally, one or more hydrolysable silanes of formula (II)



wherein the radicals X are as defined for formula (I).

See, e.g., page 2, lines 8-23 and page 7, lines 10-11 from the bottom of the present specification.

#### VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

The broad issues under consideration are:

1. Whether claims 11-27 are properly rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by SCHMIDT et al., U.S. Patent No. 6,287,639 (hereafter “SCHMIDT I”) as allegedly evidenced by MDDS data sheet of Sigma-Aldrich, i.e., whether

SCHMIDT I discloses each and every limitation of claims 11-27 either explicitly or inherently.

2. Whether claims 11, 17 and 18 are properly rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by SCHMIDT et al., U.S. Patent No. 6,378,599 (hereafter “SCHMIDT II”) as allegedly evidenced by MDDS data sheet of Sigma-Aldrich, i.e., whether SCHMIDT II discloses each and every limitation of claims 11, 17 and 18 either explicitly or inherently.

3. Whether claims 28-30 are properly rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Espin et al., U.S. Patent No. 6,513,592 (hereafter “ESPIN”) in view of SCHMIDT I as allegedly evidenced by MDDS data sheet of Sigma-Aldrich, and in particular, whether the disclosures of ESPIN and SCHMIDT I are sufficient to establish a *prima facie* case of obviousness of the subject matter of claims 28-30.

## VII. ARGUMENTS

### A. Citation of Authority

#### 1. Anticipation

Anticipation under 35 U.S.C. § 102 requires the disclosure in a single piece of prior art to show each and every limitation of a claimed invention. *Celeritas Technologies, Ltd. v. Rockwell International Corporation*, 150 F.3d 1354, 1360, 47 USPQ 2d 1516, 1522 (Fed. Cir. 1998); *Oakley, Inc. v. Sunglass Hut International*, 65 USPQ2d 1321, 1325 (Fed. Cir. 2003); *Applied Medical Resources Corporation v. United States Surgical Corporation*, 147 F.3d 1374, 1377, 47 USPQ2d 1289, 1291 (Fed. Cir.

1998); *Rockwell International Corporation v. The United States, et al.*, 147 F.3d 1358, 47 USPQ2d 1027, 1029 (Fed. Cir. 1998).

An "anticipating" reference must describe all of the elements and limitations of the claim as arranged in the claim in a single reference, and enable one of skill in the field of the invention to make and use the claimed invention. *Bristol-Myers Squibb Co. v. Ben Venue Labs., Inc.*, 246 F.3d 1368, 1378-79 (Fed. Cir. 2001); *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226 (Fed. Cir. 1989); *Merck & Co., Inc. v. Teva Pharmaceuticals USA, Inc.* 347 F.3d 1367 (Fed. Cir. 2003); *NetMoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359 (Fed. Cir. 2008).

A prior art reference anticipates a patent claim if the reference discloses, either expressly or inherently, all of the limitations of the claim. *EMI Group N. Am., Inc. v. Cypress Semiconductor Corp.*, 268 F.3d 1342, 1350 (Fed. Cir. 2001); *Schering Corp. v. Geneva Pharm.*, 339 F.3d 1373, 1379 (Fed. Cir. 2003).

In order to be anticipating, a prior art reference must be enabling so that the claimed subject matter may be made or used by one skilled in the art. *Amgen Inc. v. Hoechst Marion Roussel, Inc.* 314 F.3d 1313, 1354 (Fed. Cir. 2003).

If a reference does not expressly set forth a particular element of a claim, that reference may still anticipate the claim if the element is "inherent" from the reference. Matter is "inherent" if the extrinsic evidence makes it clear that the matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill. *Titanium Metals Corp. v. Banner*, 778 F.2d 775 (Fed. Cir. 1985); *In re Cruciferous Sprout Litig.*, 301 F.3d 1343, 1349-50 (Fed. Cir. 2002); *In re Crish*, 393 F.3d 1253, 1258-59 (Fed. Cir. 2004). Inherency, however, cannot arise from

probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient. To the contrary, a certain thing must result from a given set of circumstances to be inherent. *In re Robertson*, 49 USPQ2d 1949, 1950-51 (Fed. Cir. 1999).

## **2. Obviousness**

The appropriate starting point for a determination of obviousness is stated in *Graham v. John Deere Co.*, 383 U.S. 1, 17, 148 U.S.P.Q. 459, 466 (1966):

Under § 103, the scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained and the level of ordinary skill in the pertinent art resolved. Against this background, the obviousness or nonobviousness of the subject matter is determined.

The test of obviousness *vel non* is statutory and requires a comparison of the claimed subject matter as a whole with the prior art to which the subject matter pertains. *In re Brouwer*, 77 F.3d, 422, 37 U.S.P.Q. 2d 1663 (Fed. Cir. 1996); *In re Ochiai*, 71 F.3d 1565, 37 U.S.P.Q. 2d 1127 (Fed. Cir. 1995).

Often, it will be necessary to look to interrelated teachings of multiple patents; the effects of demands known to the design community or present in the marketplace; and the background knowledge possessed by a person having ordinary skill in the art to determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue. This analysis should be made explicit. There must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness. *KSR Int'l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1740-1741. "A patent composed of several elements is not proved obvious merely by demonstrating that

each of its elements was, independently, known in the prior art. Although common sense directs one to look with care at a patent application that claims as innovation the combination of two known devices according to their established functions, it can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does.” *Id.*, at 1741.

“If the Examiner fails to establish a *prima facie* case, the rejection is improper and will be overturned.” *In re Rijckaert*, 9 F.3d, 1532, 28 U.S.P.Q.2d, 1956 (Fed. Cir. 1993), citing *In re Fine*, 837 F.2d 1071, 1074, 5 U.S.P.Q.2d 1596, 1598 (Fed. Cir. 1988).

**B. Claims 11-27 Are Not Properly Rejected Under 35 U.S.C. 102(b) As Being Anticipated By SCHMIDT I As Evidenced by MSDS Data Sheet**

**1. Summary of Rejection**

The rejection asserts, *inter alia*, that SCHMIDT I “teaches a silane composition for molded articles (Examples 3, 6, 7, 12) and consolidating (col. 5, line 33) substrate [*sic*], comprising at least one of porous materials such as sand and clay (col. 2, lines 11-13), wherein the silane comprises at least one of a hydrolysate (col. 3, lines 59-60) and a precondensate (col. 3, lines 56-59) of (a) one or more silanes of formula(I)  $R_xSiA_{4-x}$  (col. 1, lines 9-18), wherein the radicals R independently represent non-hydrolysable groups (col. 1, lines 13-15), the radicals A independently represent hydrolysable groups or hydroxyl groups (col. 1, lines 12-14), x is 0,1,2 or 3 and  $x \geq 1$  in at least 50 mol % of the silane. [SCHMIDT I] further teaches examples of silanes such as phenyltriethoxysilane and tetraethoxysilane (col. 5, line 50-55), both are liquid as evidenced in MSDS data sheet of Sigma-Aldrich.” Paragraph bridging pages 3 and 4 of the July 8, 2009 Final



Office Action. At page 2, last paragraph of the July 8, 2009 Final Office Action the Examiner further alleges that “[b]oth [SCHMIDT I] and [SCHMIDT II] expressly teaches [*sic*] one or more silanes for surface modification ... . As a result of the surface modification, it is the composite contains nanoparticles not the silanes”.

## **2. Traverse**

### **a. SCHMIDT I fails to disclose a particle-free consolidation agent**

Appellants submit that the consolidation agent recited in present independent claim 11 is particle-free and for this reason alone, SCHMIDT I is unable to anticipate the claimed consolidation agent.

Particularly from the Examiner’s comments at page 2 of the July 8, 2009 Final Office Action cited above it appears that the rejection is based on the Examiner’s incorrect interpretation of the disclosure of the “consolidation agents” in SCHMIDT I (and SCHMIDT II). In view thereof, the disclosure of SCHMIDT I in this regard will in the following be discussed in detail to make it evident that the “consolidation agents” of SCHMIDT I (and SCHMIDT II) are not (liquid) silanes, but nanocomposites which comprise (a) hydrolysates and/or precondensates of silanes and (b) (colloidal inorganic) particles, and in particular, particles (b) which are surface-modified by the hydrolysates and/or precondensates (a).

For example, col. 1, lines 3-24 of SCHMIDT I specifically relied on by the Examiner states (emphasis added):

The invention relates to composite materials characterized by a substrate and by a nanocomposite which is in functional contact with the substrate and is obtainable by surface modification of

- a) colloidal inorganic particles with
- b) one or more silanes of the general formula (I)



where the radicals A are identical or different and are hydroxyl groups or groups which can be removed hydrolytically, except methoxy, the radicals R are identical or different and are groups which cannot be removed hydrolytically and x is 0, 1, 2 or 3, where  $x \geq 1$  in at least 50 mol % of the silanes;

under the conditions of the sol-gel process with a sub-stoichiometric amount of water, based on the hydrolysable groups which are present, with formation of a nanocomposite sol, and further hydrolysis and condensation of the nanocomposite sol, if desired, before it is brought into contact with the substrate, followed by curing, said substrate not being a glass or mineral fibre or a vegetable material.

Further, in the passage from col. 3, line 54 to col. 5, line 1 thereof SCHMIDT I teaches (emphasis added):

The silanes of the general formula (I) used according to the invention may be employed wholly or partially in the form of precondensates, i.e. compounds produced by partial hydrolysis of the silanes of the formula (I), either alone or in a mixture with other hydrolysable compounds. Such oligomers, preferably soluble in the reaction medium, may be straight-chain or cyclic low-molecular-weight partial condensates (polyorgano-siloxanes) having a degree of condensation of e.g. from about 2 to 100, in particular from about 2 to 6.

The amount of water employed for hydrolysis and condensation of the silanes of the formula (I) is preferably from 0.1 to 0.9 mol, and particularly preferably from 0.25 to 0.75 mol, of water per mole of the hydrolysable groups which are present. Particularly good results are often achieved with from 0.35 to 0.45 mol of water per mole of the hydrolysable groups which are present.

Specific examples of colloidal inorganic particles (a) are sols and powders dispersible at the nano level (particle size preferably up to 300 nm, in particular up to 100 nm and particularly preferably up to 50 nm) of SiO<sub>2</sub>, TiO<sub>2</sub>, ZrO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, Y<sub>2</sub>O<sub>3</sub>, CeO<sub>2</sub>, SnO<sub>2</sub>, ZnO, iron oxides or carbon (carbon black and graphite), in particular of SiO<sub>2</sub>.

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The hydrolysis and condensation is carried out under sol-gel conditions in the presence of acid condensation catalysts (e.g. hydrochloric acid) at a pH of preferably from 1 to 2, until a viscous sol is produced.

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In order to achieve a favourable sol particle morphology and sol viscosity, the resultant nanocomposite sol is preferably subjected to a special post-reaction step in

which the reaction mixture is heated to temperatures of from 40 to 120°C. over a period of from a number of hours to a number of days. Special preference is given to storage for one day at room temperature or heating for a number of hours at from 60 to 80 °C. This gives a nanocomposite sol with a viscosity of preferably from 5 to 500 mPas, particularly preferably from 10 to 50 mPas. ...

The proportion by weight of the nanocomposite in the composite material is preferably from 0.1 to 80% by weight, in particular from 1 to 40% by weight, and particularly preferably from 1 to 20% by weight.

The substrate and the nanocomposite or nanocomposite sol are combined after at least initial hydrolysis of component (b) and in any case before final curing. Before it is brought into contact with the substrate, the nanocomposite sol is preferably activated by feeding in a further amount of water.

The contact can be brought about by any means known to the person skilled in the art and deemed to be useful for the particular case, e.g. by simple mixing of substrate and nanocomposite sol, dipping, spraying or showering, knife- or spin-coating, pouring, spreading, brushing, etc., into the or with the nanocomposite sol.

...

In other words, according to SCHMIDT I a substrate which may be considered to correspond to the “molded articles and geological formations comprising at least one of porous materials and particulate materials” recited in instant claim 11 is contacted with a nanocomposite (sol) which may be considered to correspond to the consolidation agent for these “molded articles and geological formations” recited in present claim 11. This nanocomposite (sol) is prepared by combining, under conditions of the sol-gel process, colloidal inorganic particles with one or more silanes of the general formula (I) and water, resulting in a surface-modification of the colloidal inorganic particles with a hydrolysate/precondensate of the one or more silanes of the general formula (I). Consequently, the “consolidation agent” of SCHMIDT I (= the nanocomposite (sol)) necessarily contains particles, i.e., (surface-modified) colloidal inorganic particles.

The above process is illustrated by, for example, the procedure described in Example 6 of SCHMIDT I (one of the Examples of SCHMIDT I specifically relied on in the present rejection):

803 ml of MTEOS and 223 ml of TEOS are mixed and divided in a ratio of 1:1. Half of the silane mixture is intensively stirred with 165 g of ZrO<sub>2</sub> sol (NZS-30A from Nissan Chemicals) and 4.4 g of concentrated hydrochloric acid, and mixed, after 5 minutes, with the second half of the silane mixture.

After a post-reaction phase of 12 hours, the binder is intensively mixed with 10% by volume of water and stirred for a further 5 minutes. To the resultant mixture, boron nitride with a mean particle size of 1 μm is added in an amount such that 85% of the total material consists of boron nitride. The resultant material is spread onto a glass plate at a thickness of about 0.5 mm. After drying for 12 hours at room temperature, the layer is removed and sintered at 500° C. as a free-standing body, giving a solid shaped article.

Accordingly, Example 6 of SCHMIDT I describes the consolidation of a substrate, i.e., boron nitride powder with a binder (nanocomposite (sol)) according to the teaching of SCHMIDT I to form a solid shaped article made of bonded (or “consolidated”) boron nitride powder. The binder is prepared by surface-modification of colloidal ZrO<sub>2</sub> particles with a hydrolysate/precondensate of a mixture of methyltriethoxysilane and tetraethoxysilane. In view thereof, it is apparent that the binder for the boron nitride powder (particles) contains particles as well, i.e., (surface-modified) colloidal ZrO<sub>2</sub> particles. The same conclusion can be drawn from the remaining Examples of SCHMIDT I, wherein in some cases colloidal SiO<sub>2</sub> particles (silica sol) are used instead of colloidal ZrO<sub>2</sub> particles for making the agent for the consolidation and/or coating of various substrates.

To make the difference between the (nanoparticle-containing) “consolidation agent” of SCHMIDT I and the particle-free consolidation agent recited in instant claim

11 even more apparent, the procedure of Example 6 of SCHMIDT I may be compared with the procedures described in the Examples of the present application. For example, Example 2 at pages 10 and 11 of the present application states:

#### EXAMPLE 2

Preparation of a particle-free consolidation agent for the purpose of solidifying sand

13.75 g of MTEOS and 64.33 g of TEOS are mixed and reacted with 22.15 g of deionized water and 0.22 ml of concentrated hydrochloric acid (37%) with intensive stirring. After the end point the reaction mixture exceeds a maximum temperature of 73°C. After cooling the reaction mixture to 58°C, a further silane mixture consisting of 22.1 g of phenyltriethoxysilane, 49.1 g of MTEOS and 19.1 g of TEOS is added to the batch and stirring is continued for 5 minutes. After standing overnight the batch is adjusted to a pH value of about 3 with 0.25 ml of an ethanolic (21% by weight) Na ethoxylate solution.

Prior to processing, 5% by weight of water are added to the consolidation agent for activation. The consolidation agent activated can be used for solidifying sand. For that, for example 12 g of activated consolidation agent are added to 100 g of sand and mixed homogeneously. After evaporation of ethanol the mixture obtained is packed into a mould, compressed at a press and cured at 150°C overnight.

The above procedure has in common with the procedure described in Example 6 of SCHMIDT I that a mixture of silanes is hydrolysed/precondensed by contacting the mixture with water in the presence of hydrochloric acid as hydrolysis and condensation catalyst and that the resultant product (precondensate, consolidation agent) is used to consolidate a particulate material (boron nitride in the case of Example 6 of SCHMIDT I and sand in the case of Example 2 of the present application).

However, the procedure described in Example 2 of the present application differs from the procedure described in Example 6 of SCHMIDT I in that in Example 2 of the present application the hydrolysis and precondensation of the silane mixture is carried out

in the absence of any particles (e.g., the colloidal inorganic particles taught by SCHMIDT I), whereas the hydrolysis and precondensation of the silane mixture in Example 6 of SCHMIDT I is carried out in the presence of particles, i.e., colloidal  $\text{ZrO}_2$  particles ( $\text{ZrO}_2$  sol).

In other words, the consolidation agent of Example 2 of the present application is particle-free, whereas the consolidation agent of Example 6 of SCHMIDT I contains particles (colloidal  $\text{ZrO}_2$  particles).

In view of the Examiner's comments it is pointed out that while it is correct that the silanes used by SCHMIDT I are particle-free, these silanes are not the "consolidation agent" (binder) disclosed by SCHMIDT I. Rather, the "consolidation agent" of SCHMIDT I is made from these silanes by hydrolysis/precondensation thereof with water (using hydrochloric acid as catalyst) in the presence of colloidal inorganic particles (or, as represented by SCHMIDT I, by surface-modifying the colloidal inorganic particles by the product of the hydrolysis/precondensation of the silanes).

Appellants further note that SCHMIDT I in some instances refers to the combination of substrate plus binder as "composite" or "composite material" (see, e.g. col. 4, lines 53-56). It is pointed out that the term "composite" must not be confused with the term "nanocomposite" also mentioned by SCHMIDT I, which latter term denotes only a component of the "composite", i.e., the surface-modified colloidal inorganic particles which serve as the binder for the substrate (and in combination with the substrate represent the "composite").

It is submitted that for at least all of the foregoing reasons, the Examiner is clearly mistaken in the assessment that SCHMIDT I discloses particle-free “consolidation agents” as recited in instant independent claim 11. For this reason alone, the rejection of claims 11-27 under 35 U.S.C. § 102(b) as allegedly anticipated by SCHMIDT I is without merit.

**b. Claims 17 and 18**

Appellants further point out that it is not seen that SCHMIDT specifically teaches a hydrolysate and/or a precondensate of a combination of silanes comprising (a1) an alkylsilane, (a2) an arylsilane and (b) an orthosilicic ester as recited in instant claim 17, let alone a hydrolysate and/or a precondensate of a combination of silanes which comprise methyltriethoxysilane, phenyltriethoxysilane and tetraethoxysilane as recited in instant claim 18. In this regard, the rejection relies on col. 3, line 30 and Example 1 of SCHMIDT I (see page 5, first paragraph of the July 8, 2009 Final Office Action). However, it is not seen that these passages of SCHMIDT I disclose the combinations of silanes recited in claims 17 and 18. This is yet another reason (i.e., in addition to the reasons set forth above in section VII.B.2.a.), why SCHMIDT I is unable to anticipate the subject matter of claims 17 and 18.

**C. Claims 1, 17 And 18 Are Not Properly Rejected Under 35 U.S.C. 102(b) As Being Anticipated By SCHMIDT II As Evidenced by MSDS Data Sheet**

**1. Summary of Rejection**

The rejection alleges, *inter alia*, that SCHMIDT II “teaches a silane composition (col. 1. Line 4, “binder”) for molded articles (col. 3, line 56) and consolidating sands

(Examples 1, 2) and inorganic particles (col. 3, line 11), wherein the silane comprises at least one of a hydrolysate (col. 2, lines 59-60) and a precondensate (col. 2, lines 56-60) of (a) one or more silanes of formula(I)  $R_xSiA_{4-x}$  (col. 1, lines 8-10), wherein the radicals R independently represent non-hydrolysable groups (col. 1, lines 13-15), the radicals A independently represent hydrolysable groups or hydroxyl groups (col. 1, lines 11-13), x is 0,1,2 or 3 and  $x \geq 1$  in at least 50 mol % of the silane. [SCHMIDT II] further teaches examples of silanes such as phenyltriethoxysilane and tetraethoxysilane (col. 4, line 25-30), both are liquid as evidenced in MSDS data sheet of Sigma-Aldrich.” Paragraph bridging pages 6 and 7 of the July 8, 2009 Final Office Action. At page 2, last paragraph of the July 8, 2009 Final Office Action the Examiner further alleges that “[b]oth [SCHMIDT I] and [SCHMIDT II] expressly teaches [*sic*] one or more silanes for surface modification ... . As a result of the surface modification, it is the composite contains nanoparticles not the silanes”.

## 2. Traverse

Appellants submit that the consolidation agent recited in present independent claim 11 is particle-free and for this reason alone, SCHMIDT II is unable to anticipate the claimed consolidation agent. For example, SCHMIDT II (which claims the priority of German patent application 196 47 368, i.e., the priority which is also claimed by SCHMIDT I discussed above) states in col. 1, lines 4-27 (emphasis added):

The invention relates to a foundry binder which is obtainable by surface modification of

- a) colloidal inorganic particles with
- b) one or more silanes of the general formula (I)





where the radicals A are identical or different and are hydroxyl groups or groups which can be removed hydrolytically, except methoxy, the radicals R are identical or different and are groups which cannot be removed hydrolytically and x is 0, 1, 2 or 3, where  $x \geq 1$  in at least 50 mol % of the silanes;

under the conditions of the sol-gel process with a sub-stoichiometric amount of water, based on the hydrolysable groups which are present, with formation of a nanocomposite sol, and further hydrolysis and condensation of the nanocomposite sol, if desired, before it is brought into contact with the foundry sand.

The nanocomposite sol employed according to the invention is prepared by surface-modification of colloidal inorganic particles (a) with one or more silanes (b), if desired in the presence of other additives (c) under the conditions of the sol-gel process.

Further, in the passage from col. 2, line 56 to col. 3, line 59 SCHMIDT II teaches (emphasis added):

The silanes of the general formula (I) used according to the invention may be employed wholly or partially in the form of precondensates, i.e. compounds produced by partial hydrolysis of the silanes of the formula (I), either alone or in a mixture with other hydrolysable compounds. Such oligomers, preferably soluble in the reaction medium, may be straight-chain or cyclic low-molecular-weight partial condensates (polyorgano-siloxanes) having a degree of condensation of e.g. from about 2 to 100, in particular from about 2 to 6.

The amount of water employed for hydrolysis and condensation of the silanes of the formula (I) is preferably from 0.1 to 0.9 mol, and particularly preferably from 0.25 to 0.75 mol, of water per mole of the hydrolysable groups which are present. Particularly good results are often achieved with from 0.35 to 0.45 mol of water per mole of the hydrolysable groups which are present.

Specific examples of colloidal inorganic particles (a) are sols and powders dispersible at the nano level (particle size preferably up to 300 nm, in particular up to 100 nm and particularly preferably up to 50 nm) of SiO<sub>2</sub>, TiO<sub>2</sub>, ZrO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, Y<sub>2</sub>O<sub>3</sub>, CeO<sub>2</sub>, SnO<sub>2</sub>, ZnO, iron oxides or carbon (carbon black and graphite), in particular of SiO<sub>2</sub>.

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The hydrolysis and condensation is carried out under sol-gel conditions in the presence of acid condensation catalysts (e.g. hydrochloric acid) at a pH of preferably from 1 to 2, until a viscous sol is produced.

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In order to achieve a favourable sol particle morphology and sol viscosity, the resultant nanocomposite sol is preferably subjected to a special post-reaction step in which the reaction mixture is heated to temperatures of from 40 to 120 °C. over a

period of from a number of hours to a number of days. Special preference is given to storage for one day at room temperature or heating for a number of hours at from 60 to 80 °C. This gives a nanocomposite sol with a viscosity of preferably from 5 to 500 mPas, particularly preferably from 10 to 50 mPas. ...

The nanocomposite sol and the foundry sand are combined after at least initial hydrolysis of component (b) and in any case before final curing. Before it is brought into contact with the sand, the nanocomposite sol is preferably activated by feeding in a further amount of water.

For the production of foundry molds and cores, the nanocomposite sol is admixed with the foundry mold or core sand in the usual amounts, e.g. in an amount of from 0.1 to 20% by weight.

In other words, according to SCHMIDT II a nanocomposite sol (which may be considered to correspond to the “consolidation agent for molded articles and geological formations” recited in instant claim 11) is used as a binder for foundry sand (which may be considered to be encompassed by the “molded articles and geological formations comprising at least one of porous materials and particulate materials” recited in present claim 11).

The nanocomposite sol is prepared by combining colloidal inorganic particles, one or more silanes of the general formula (I) and water under conditions of the sol-gel process, resulting in the surface-modification of the colloidal inorganic particles with a hydrolysate/precondensate of the one or more silanes of the general formula (I). Accordingly, there can be no doubt that the binder of SCHMIDT II necessarily contains particles, i.e., (surface-modified) colloidal inorganic particles.

The above process is illustrated by, for example, the procedure described in Example 1 of SCHMIDT II (one of the Examples of SCHMIDT II specifically relied on in the present rejection):

51.3 ml of MTEOS (corresponding to 60 mol %), 19.1 ml of TEOS (corresponding to 20 mol %) and 15.0 ml of PTEOS (corresponding to 20 mol %)

are mixed, and half of this mixture is vigorously stirred with 11.7 ml of silica sol (corresponding to a proportion of silica sol of 14.3% by weight) and 0.386 ml of concentrated hydrochloric acid. After 5 minutes, the second half of the alkoxide mixture is added to the charge and then stirring is continued for a further 5 minutes. The resultant sol is then subjected to a post-reaction step (standing at 60° C. for 12 hours).

About 2.5 ml of water are added to the sol before it is used, in order to reach a water content of 0.5 mol of water per mole of hydrolysable group. The resultant sol is mixed with an amount of sand of a particle size of about 1 mm, so that about 84% of the total weight consists of the sand. The material is tamped in a mould and hardened at 100° C. for 20 minutes, giving a mechanically robust shaped article which does not lose its shape even after exposure to a temperature of 500° C. for 1 hour.

Accordingly, Example 1 of SCHMIDT II describes the consolidation of (foundry) sand by means of a binder, i.e., a sol, to form a mechanically robust shaped article. The sol is prepared by contacting colloidal inorganic ( $\text{SiO}_2$ ) particles in the form of a silica sol with a mixture of silanes and water under the conditions of the sol-gel process, resulting in the surface-modification of the inorganic particles with a hydrolysate/precondensate of the mixture of the silanes employed. Again, there can be no doubt that the sol used as a binder for the sand necessarily contains particles, i.e., (surface-modified) colloidal  $\text{SiO}_2$  particles.

To make the difference between the (colloidal inorganic particle containing) “consolidation agent” of SCHMIDT II and the particle-free consolidation agent of the present invention even more apparent, the procedure of Example 6 of SCHMIDT I may be compared with the procedures described in the Examples of the present application. For example, Example 2 at pages 10 and 11 of the present application states:

## EXAMPLE 2

Preparation of a particle-free consolidation agent for the purpose of solidifying sand

13.75 g of MTEOS and 64.33 g of TEOS are mixed and reacted with 22.15 g of deionized water and 0.22 ml of concentrated hydrochloric acid (37%) with intensive stirring. After the end point the reaction mixture exceeds a maximum temperature of 73°C. After cooling the reaction mixture to 58°C, a further silane mixture consisting of 22.1 g of phenyltriethoxysilane, 49.1 g of MTEOS and 19.1 g of TEOS is added to the batch and stirring is continued for 5 minutes. After standing overnight the batch is adjusted to a pH value of about 3 with 0.25 ml of an ethanolic (21% by weight) Na ethoxylate solution.

Prior to processing, 5% by weight of water are added to the consolidation agent for activation. The consolidation agent activated can be used for solidifying sand. For that, for example 12 g of activated consolidation agent are added to 100 g of sand and mixed homogeneously. After evaporation of ethanol the mixture obtained is packed into a mould, compressed at a press and cured at 150°C overnight.

The above procedure has in common with the procedure described in Example 1 of SCHMIDT II that a mixture of silanes is hydrolysed/precondensed by contacting the mixture with water in the presence of hydrochloric acid as hydrolysis and condensation catalyst and that the resultant product (precondensate, consolidation agent) is used to consolidate a particulate material (foundry sand in the case of Example 1 of SCHMIDT II and (regular) sand in the case of Example 2 of the present application).

However, the procedure described in Example 2 of the present application differs from the procedure described in Example 1 of SCHMIDT II in that in Example 2 of the present application the hydrolysis and precondensation of the silane mixture is carried out in the absence of any particles, whereas the hydrolysis and precondensation of the silane mixture in Example 1 of SCHMIDT II is carried out in the presence of (nano)particles, i.e., colloidal SiO<sub>2</sub> particles (silica sol).

In other words, the consolidation agent of Example 2 of the present application is particle-free, whereas the binder of Example 1 of SCHMIDT II contains nanoparticles (colloidal SiO<sub>2</sub> particles).

It is submitted that for at least all of the foregoing reasons, SCHMIDT II fails to anticipate the subject matter of any of claims 11, 17 and 18, wherefore the rejection of these claims under 35 U.S.C. § 102(b) over SCHMIDT II is clearly without merit.

**D. Claims 28-30 Are Not Properly Rejected Under 35 U.S.C. 103(a) As Being Unpatentable Over ESPIN In View Of SCHMIDT I As Evidenced by MSDS Data Sheet**

**1. Summary of Rejection**

The rejection alleges that ESPIN teaches a process for consolidating sand formations comprising injecting a consolidation system into the formation and curing thereof and further teaches the consolidation system is a fluid suspension of nanoparticles as disclosed in PCT/EP97/06370, of which SCHMIDT I is the English equivalent. The rejection concedes that ESPIN does not teach the claimed consolidation agent but alleges that “[a]t the time of the invention it would have been obvious to a person of ordinary skill in the art to inject the agent of claim 11 into the formation and curing thereof for the benefit of consolidating sand formations, because [ESPIN] expressly teaches the particles of PCT/EP97/06370..., of which [SCHMIDT I] is the English equivalent. While teaching a particle modified by silanes, the silanes of [SCHMIDT I] is [*sic*] particle-free (as detailed above) and function as a surface modifying and bonding agent ...”. Page 8, second paragraph of the July 8, 2009 Final Office Action.

## 2. Traverse

Appellants note that claim 28 (from which claims 29 and 30 depend) is drawn to a process for consolidating a geological formation which is at least one of porous and particulate, which process comprises injecting the consolidation agent recited in independent claim 11 into the formation and/or infiltrating the formation with the agent of claim 11 and thereafter curing the agent. Claim 11 in turn specifically recites that the consolidation agent set forth therein is particle-free.

In contrast to the process of instant claim 28 and as (implicitly) acknowledged by the Examiner, a critical feature of the method taught by ESPIN is the use of a composition which comprises nanoparticles. For example, the abstract of ESPIN states (emphasis added):

A method is disclosed for consolidating an unconsolidated formation, which method includes the steps of providing a well drilled to an unconsolidated formation, providing a consolidation fluid in the form of a fluid suspension of nanoparticles, and flowing said consolidation fluid through the well and into the unconsolidated formation so as to position the nanoparticles between grains of the unconsolidated formation whereby the formation is consolidated over time.

Further, in col. 2, lines 47-63 ESPIN explains the important function of nanoparticles for the method taught therein (emphasis added):

... Following injection of the displacement fluid, a consolidation system **16** is then injected. In accordance with the present invention, the consolidation system **16** is a fluid suspension of nanoparticles, preferably an aqueous suspension of nanoparticles as will be more thoroughly discussed below.

During this injection, nanoparticles lodge between loose grains of the unconsolidated formation. Consolidation occurs over time, and can be expedited as described below, wherein the nanoparticles form a bond of sufficient strength with adjacent contacting grains of sand that the Young's Modulus of the formation is substantially increased, for example to values of greater than or equal to about  $1 \times 10^6$  psi. This is a substantial improvement as compared to untreated unconsolidated formations which can frequently have a Young's Modulus of less than or equal to about  $0.4 \times 10^6$  psi.

Even further, in col. 3, lines 5-19, ESPIN states (emphasis added):

The nanoparticles of the present invention are provided having an average particle size of between about 1 nanometer ( $10^{-9}$  m) (nm) and about 200 nanometers ( $10^{-9}$  m) (nm). The nanoparticles are formed of molecules of organic and inorganic components. The inorganic component has an affinity for the sand grains of the formation. Thus, SiO<sub>2</sub>, for example, is suitable as the inorganic compound, particularly, silica and/or quartz. The organic component allows for polymerization bonding of the inorganic component to the contacting sand grains of the formation under certain pH conditions as explained hereinbelow. Suitable organic components include, for example, silanes, hydroxyls and/or alkaloids. Suitable nanoparticle materials for use in the method of the present invention include those disclosed in PCT/EP97/06370 published May 28, 1998.

The above statements in ESPIN make it abundantly clear that nanoparticles are a critical and indispensable feature of the method disclosed therein, wherefore ESPIN not only fails to render it obvious to one of ordinary skill in the art to employ the particle-free consolidation agent recited in instant independent claim 11 for the purposes disclosed by ESPIN, but even teaches away therefrom.

Moreover, the passage in col. 3, lines 5-19 of ESPIN reproduced above is an independent confirmation of the fact that the “consolidation agent” of SCHMIDT I (i.e., the U.S. equivalent of PCT/EP97/06370 mentioned in this passage) contains (nano)particles, contrary to the Examiner’s position in this regard.

In view of the Examiner’s comments it is pointed out again that while it is correct that the silanes used by SCHMIDT I are particle-free, these silanes are not the “consolidation agent” disclosed by SCHMIDT I. Rather, the “consolidation agent” of SCHMIDT I is made from these silanes by hydrolysis/precondensation thereof with water (using hydrochloric acid as catalyst) in the presence of colloidal inorganic particles (or, as represented by SCHMIDT I, by surface-modifying the colloidal inorganic particles by the product of the hydrolysis/precondensation of the silanes).

It is submitted that view of the foregoing, ESPIN in view of SCHMIDT I (as evidenced by MDDS data sheet of Sigma-Aldrich) is unable to render obvious the process recited in any of claims 28-30, wherefore the Examiner has failed to establish a *prima facie* case of obviousness of the subject matter of claims 28-30 over ESPIN in view of SCHMIDT I.

### VIII. CONCLUSION

Appellants respectfully submit that for at least all of the foregoing reasons, the Examiner has failed to establish that claims 1-27 are anticipated by SCHMIDT I and has failed to establish that claims 1, 17 and 18 are anticipated by SCHMIDT II. The Examiner also has failed to establish a *prima facie* case of obviousness of the subject matter of claims 28-30 over ESPIN in view of SCHMIDT I. The Board is, therefore, respectfully requested to reverse the Final Rejection, and to allow the application to issue in its present form.

Respectfully submitted,  
Klaus ENDRES et al.

/Heribert F. Muensterer/

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**CLAIMS APPENDIX**

11. A consolidation agent for molded articles and geological formations comprising at least one of porous materials and particulate materials, wherein the agent is particle-free and comprises at least one of a hydrolysate and a precondensate of (a) one or more organosilanes of formula (I)



wherein the radicals R independently represent non-hydrolysable groups, the radicals X independently represent hydrolysable groups or hydroxyl groups, and n is 1, 2 or 3; and (b) optionally, one or more hydrolysable silanes of formula (II)



wherein the radicals X are as defined for formula (I).

12. The agent of claim 11, wherein the radicals X comprise one or more radicals selected from halogen, alkoxy and acyloxy groups.

13. The agent of claim 12, wherein the radicals X comprise one or more radicals selected from C<sub>2-4</sub> alkoxy groups.

14. The agent of claim 11, wherein the radicals R comprise one or more radicals selected from C<sub>1-4</sub> alkyl groups and aryl groups.

15. The agent of claim 14, wherein the radicals R comprise one or more radicals selected from methyl and ethyl.

16. The agent of claim 15, wherein the radicals R comprise a phenyl group.
17. The agent of claim 11, wherein the agent comprises at least one of a hydrolysate and a precondensate of compounds comprising (a1) an alkylsilane, (a2) an arylsilane and (b) an orthosilicic ester.
18. The agent of claim 17, wherein the agent comprises at least one of a hydrolysate and a precondensate of compounds which comprise methyltriethoxysilane, phenyltriethoxysilane and tetraethoxysilane.
19. The agent of claim 11, wherein the at least one of a hydrolysate and a precondensate has been prepared in the presence of one or more metal compounds of formula (III)



wherein M is selected from metals of main groups I to VIII and subgroups II to VIII of the Periodic Table of Elements and wherein the radicals X independently represent hydrolysable groups or hydroxyl groups and two radicals X may be combined to form an oxo group, and a corresponds to the valence of M.

20. The agent of claim 19, wherein the one or more metal compounds comprise one or more metals M which are selected from one or more of Al, B, Sn, Ti, Zr, V and Zn.

21. The agent of claim 20, wherein the one or more metals M comprise at least one of Al, Ti and Zr.
22. The agent of claim 19, wherein the one or more metal compounds of formula (III) comprise one or more alkoxides of at least one of Na, K, Al, Zr and Ti.
23. The agent of claim 11, wherein the agent has been prepared according to a sol-gel process using a substoichiometric amount of water relative to hydrolysable radicals X present.
24. A solution or emulsion which comprises the agent of claim 11.
25. A process for preparing a consolidated molded article, wherein the process comprises at least one of mixing and coating a material which is at least one of porous and particulate with the agent of claim 11 and thereafter curing the agent.
26. The process of claim 25, wherein prior to being combined with the material the agent is activated by adding water thereto.
27. A consolidated molded article which is obtainable by the process of claim 25.
28. A process for consolidating a geological formation which is at least one of porous and particulate, wherein the process comprises at least one of injecting the agent of claim

11 into the formation and infiltrating the formation with the agent of claim 11 and thereafter curing the agent.

29. The process of claim 28, wherein the formation is oil-bearing and comprises sand.

30. A process for consolidating a geological formation, wherein the process comprises introducing consolidated molded articles of claim 27 into channels within the geological formation.

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## **EVIDENCE APPENDIX**

None.

**RELATED PROCEEDINGS APPENDIX**

None.